Method Number S-15A

# pH OF WHOLE TOBACCO SMOKE ON A PUFF-BY-PUFF BASIS

## I. INTRODUCTION AND SUMMARY

A simple reliable method for the determination of pH of whole tobacco smoke on a puff-by-puff basis has been developed after the method of Sensabaugh and Cundiff.[1] The procedure is an empirical one and the results will depend upon the conditions under which the measurements are made.

The smoke aerosol reacts with a thin film of buffer on a modified electrode and the relative response of the electrode is measured. The combination electrode is specific for hydrogen ion concentration and the values observed are indicative of the acid-base ratio of smoke. They can be used to make comparative tests only between different types of cigarettes.

The values reported will be the average of the minimum and maximum pH on a puff-by-puff basis for the second through the eighth puffs of the six cigarettes smoked.

Using the Marlboro 85mm cigarette on six determinations, the average for the minimum pH was 6.09 with a relative standard deviation at the 2 sigma level of ±1.31%. The average of the maximum pH was 6.32 with a relative standard deviation at the 2 sigma level of ±2.90%.

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II. SAMPLE REQUIREMENTS

Total sample recommended: 6 cigarettes

Sample recommended per determination: 1 cigarette

Replicate determinations normally made: 6

Man-hours per determination: 30 minutes

Man-hours for replicates: 3 hours/6 determinations

Total elapsed time: 4 hours/6 determinations



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## III. APPARATUS AND REAGENTS

### A. Apparatus

1. Smoking Machine, Phipps and Bird, Inc., Model No. 9900-300 single-port smoking machine, or equivalent, adjusted to take one 35-ml puff of 2 seconds duration once each minute.
2. Smoke Collection Assembly. See Figure 1.
3. pH Meter, Beckman-Expandomatic pH Meter Model No. 76A, or equivalent.
4. Beckman Combination Electrode No. 39183, or equivalent, modified by removing one inch of the outer glass jacket, replacing the seal with four "O" rings and adding a longer linen thread.
5. Recorder, with a range of 0.2 to 1 mv.

### B. Reagents

Buffer solutions of pH 5.0, 6.0, 7.0 and 8.0, Fisher Scientific Co., Catalog No. SO-B-102 (pH 5.00), SO-B-104 (pH 6.00), SO-B-108 (pH 7.00), and SO-B-112 (pH 8.00).

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IV. PROCEDURE

The pH of whole smoke on a puff-by-puff basis is determined by smoking six cigarettes and averaging the minimum and maximum values for the second through the eighth puffs.

1. Assemble the smoke train as shown in Figure 1.
2. Set the pH Meter on expanded pH range of 5 to 7 or 6 to 8, and adjust the meter with the pH 7 buffer solution.
3. Check the meter accuracy with the pH 6 buffer solution, then return the electrode to the pH 7 buffer solution.
4. Remove the electrode from the buffer solution and wipe with a tissue to remove the excess solution, but do not completely dry the electrode.
5. Place the electrode in the smoking assembly and observe the reading on the pH meter. The pH reading should be between 5.9 and 6.1. If necessary, repeat the above procedure until this specified pH reading is obtained.
6. Place the cigarette to be smoked into the holder, and turn on the smoking machine and recorder.
7. Light the cigarette as the first puff is taken.
8. Take the desired number of puffs or smoke the desired amount of the cigarette rod.

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9. Remove the electrode from the smoke chamber, wipe with a tissue, rinse with water, and place the electrode in pH 7 buffer solution.

10. Repeat steps 3 to 9 on 5 more cigarettes of the same sample.

NOTE: The cigarette holder, smoke chamber and Cambridge filter must be changed between each cigarette.

## V. CALCULATION

1. Read the minimum and maximum pH values for each puff from the recorder chart for the six cigarettes smoked.

2. Report the average of the minimum and maximum pH on a puff-by-puff basis for the second through the eighth puff for the six cigarettes smoked.

## VI. REFERENCES

1. Sensabaugh, A. J. and Cundiff, R. H., Tobacco Science, 11, pp. 25-30, 1967.

2. Notebook 3995, pp. 65-100.

3. Notebook 4941, pp. 38-42.

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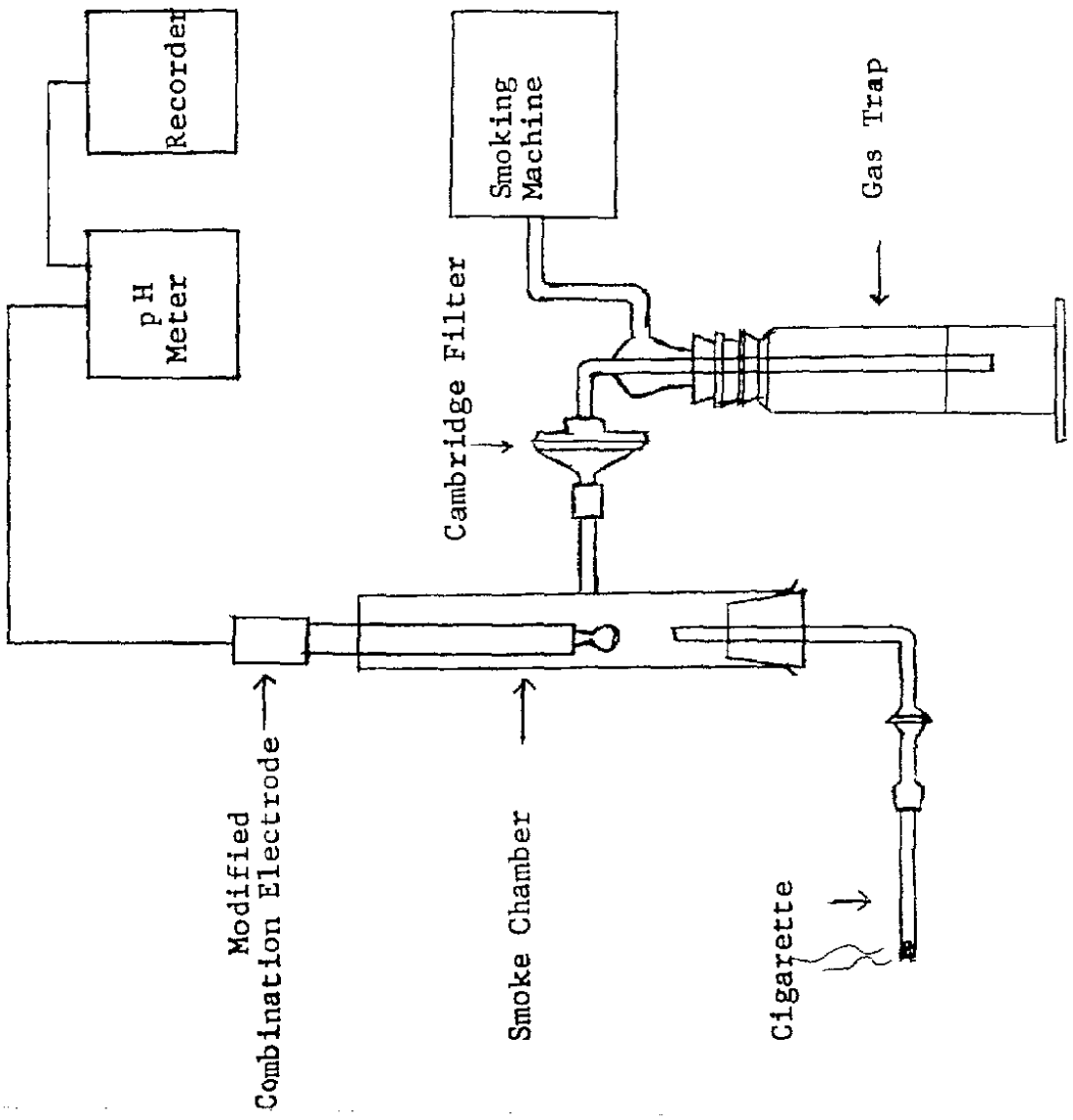
Figure 1

Smoke Train

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